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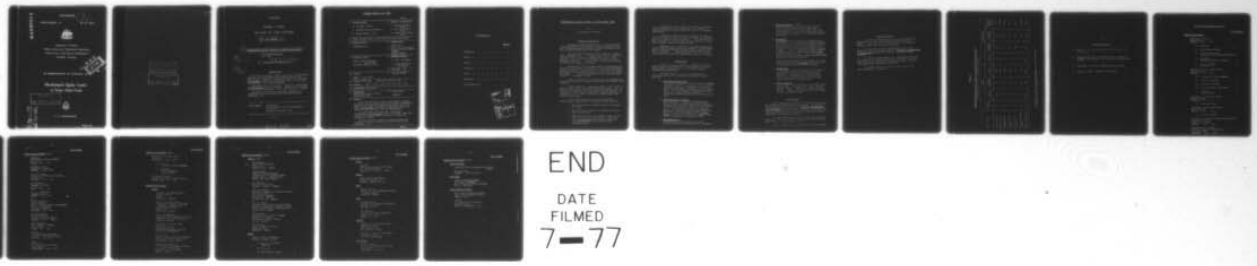

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Department of Defence
Defence Science and Technology Organisation
Armed Forces Food Science Establishment
Scottsdale, Tasmania

Microbiological Quality Control of Freeze Dried Foods

C. H. FORBES-EWAN

March, 1977

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SUMMARY

In the past two years, a total of 192 batches of freeze-dried meals have been examined for microbiological contamination. Analyses were conducted for standard plate count (SPC), coliforms, E. coli type 1, salmonellae, staphylocci, yeasts and moulds and, since November, 1976, enterobacteriaceae.

The average SPC was 310 per gram. Salmonellae, staphylococci and E. coli type 1 were not detected. Fewer than 1% of samples showed coliform contamination. Moulds were detected in 2 samples.

The quality control programme emphasizes prevention of contamination during processing rather than detection after processing. (U)

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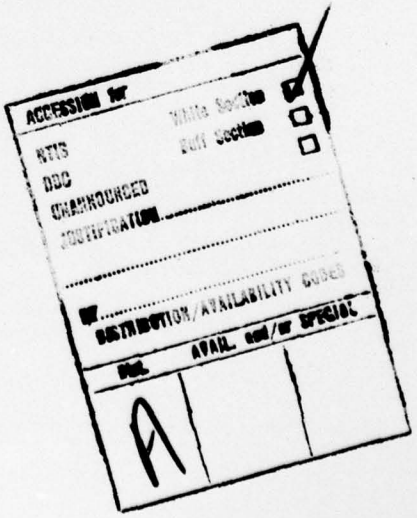

MICROBIOLOGICAL QUALITY CONTROL OF FREEZE DRIED FOODS

by

C. Forbes-Ewan, B.Sc.(Hons)

I N T R O D U C T I O N

The quality control of dried foods, as of foods generally, is often considered to be "suppressive", in that samples are taken of the finished product and a batch is accepted or rejected on the basis of results obtained with these samples.

The statistical reliability of such a system is, however, very low (Mossel, 1975). A negative result does not necessarily imply that a batch is free from contamination, as only a small proportion of the total food in each batch is sampled for microbiological examination. Contamination may be localised in parts of the food not included in the sample.

The diversity of micro organisms which can contaminate food precludes the possibility of analysing for all possible contaminants. Instead, examination is carried out for a selected group of "likely" contaminants and for indicator organisms as well as for total aerobic mesophiles. Thus some pathogens may escape detection because the food is not examined for them.

Lastly, techniques are not perfect and a small proportion of contaminated samples can be expected to pass the most stringent screening tests.

Another drawback of a suppressive system is that it fails to detect at which stage of processing contamination occurs. Thus it does not allow measures to be taken to remedy any deficiencies. To allow this, a quality control system should emphasize prevention of contamination at all stages of production to prevent rather than suppress contamination.

At the AFFSE, freeze-dried meals are examined for bacteriological contamination at four stages in their production:

1. The raw materials are visually inspected for freshness and purity.

2. The cooked meal is examined for standard plate count (SPC) and coliforms.

3. After removal from the freeze-dryer, a sample of the meal is taken for "complete analysis" - SPC, coliforms, E. coli type 1, salmonellae, staphylococci, yeasts and moulds and, since November, 1976, enterobacteriaceae.

Preventative quality control also depends on monitoring of the microbiological state of equipment, bench surfaces, the hands and uniforms of process workers and the air in the processing building.

Consequently, swabs are taken of equipment and benches in the processing area and of the hands and uniforms of processors. Swabs are examined for SPC and coliforms. Open petri dishes of plate count agar are placed at random on bench surfaces and equipment to estimate levels of air-borne bacteria.

Fundamental to this programme is the rigorous observance of high levels of personal hygiene by processors. Frequent cleaning and disinfection of hands, equipment, bench surfaces and the floor is conducted. Ultra-violet insect traps and fly-wire doors ensure that insect-borne contamination is kept to a minimum.

METHODS

As far as possible, techniques of examination for microorganisms should be standardized to allow comparison of results from different laboratories and to give practical meaning to standards and specifications.

The AFFSE observes the methods of microbiological examination prepared by the Standards Association of Australia (SAA 1975).

a. Standard Plate Count (SPC)
A 10 per cent homogenate of the food sample is produced using peptone solution. Aliquots of 1 ml from each of 3 decimal dilutions of the homogenate are plated out using Plate Count Agar. Incubation is for 72 hours at 30°C. The SPC is expressed as "organisms per gram". The current Australian Defence Forces Food Specification (ADFFS) requires the SPC to be 20,000 or less.

b. Coliforms and E. coli type 1.
The initial step is common in the examination for these organisms. Inoculation of Lauryl Sulphate Tryptone Broth (LSB) with 3 dilutions of the homogenate is followed by incubation of the LSB at 35°C for 48 hours. Confirmation of coliforms is achieved by inoculation of Brilliant Green Bile Broth (BGBB) with gas-positive LSB and incubation at 35°C. E. coli type 1 is confirmed by inoculation of BGBB with gas positive LSB followed by incubation at 44°C.

c. Enterobacteriaceae
Three dilutions of the homogenate are used to inoculate Enterobacteria Enrichment Broth (EE broth).

c. Enterobacteriaceae (Con't)
These are incubated for 24 hours at 37°C and used to streak Violet Red Bile Glucose Agar (VRBG). Plates are incubated for 24 hrs at 37°C after which enterobacteriaceae colonies are surrounded by a zone of precipitation accompanied by a purple discolouration of the agar.

d. Salmonellae
The examination for salmonellae is qualitative, not quantitative, as the specification requires salmonellae to be absent (or not detected) in 50 grams of sample. Thus examination commences with pre-enrichment of 50 grams of food in Lactose Broth, incubated overnight at 37°C. This is followed by selective enrichment in Tetrathionate and Selenite-Cystine Broths, again incubated overnight at 37°C. Next comes selective plating on Desoxycholate-Citrate Agar, Bismuth Sulphite Agar and Salmonella Shigella Agar.

Biochemical confirmatory tests are carried out at this laboratory and confirmed Salmonella cultures are sent to the Salmonella Reference Centre for typing.

e. Staphylococci
A 1 ml aliquot of the 10^{-1} dilution of the homogenate is streaked onto Baird Parker Agar which has had potassium tellurite and egg yolk emulsion added previously. Incubation is for 48 hours at 37°C. A tube coagulase test is carried out using Rabbit Plasma and Brain-Heart Infusion Broth.

f. Yeasts and Moulds
A 1 ml aliquot of the homogenate is plated onto Potato Dextrose agar. Tartaric acid is used to suppress bacterial growth. Plates are incubated for 5 days at 25°C. Results are expressed separately as yeasts per gram and moulds per gram.

RESULTS

Since January, 1975, a total of 192 freeze-dried meals has been analysed for microbiological contamination. The average SPC for the freeze-dried meals was 310. Salmonella, Staphylococcus and E. coli type 1 were not detected. Coliform contamination was found in fewer than 1 per cent of samples analysed - two batches of lamb and vegetable curry were found to have a low level of coliforms (MPN = 2 per gram and 5 per gram).

The highest SPC recorded was 18,600 in a batch of freeze-dried rice. Two other batches of rice gave SPC over 10,000. No other meal had a SPC in excess of 7,000.

Table 1 shows the results obtained for the period 1975/76.

DISCUSSION

The current Australian Defence Forces Food Specification specifies that the SPC of freeze-dried food shall not exceed 20,000. At no time in the past two years has this laboratory attained an SPC in excess of the specification.

The low level of coliform contamination and the non-detection of possibly pathogenic organisms (Salmonella, Staphylococcus and E. coli type 1) point to the success of the quality control programme.

In previous reports (Harder 1971, Forbes-Ewan 1973) it was stated that "... the total plate count (now SPC) should be reduced to suit the product (freeze-dried foods) and an absolute limit of 1,000 organisms per gram should be observed".

The results obtained over the past years indicate that this recommendation is justified.

TABLE 1*

RESULTS OF BACTERIOLOGICAL ANALYSIS OF FREEZE-DRIED FOODS 1975/76

All results are in terms of organisms per gram.

MEAL VARIETY	NO. OF SAMPLES	COOKED			FREEZE DRIED			
		SPC (AVERAGE)	COLIFORMS (AVERAGE)	SPC (MAXIMUM)	SPC (AVERAGE)	COLIFORMS (MAXIMUM)	COLIFORMS (AVERAGE)	YEASTS AND MOULDS (TOTAL)
Beef and Onions	26	120	Nil	2,400	210	Nil	Nil	Nil
Beef and Beans	28	230	Nil	1,200	480	Nil	Nil	3 moulds
Savoury Steak Fingers	30	180	Nil	1,600	240	Nil	Nil	1 mould
Sweet and Sour Pork	24	640	Nil	1,720	290	Nil	Nil	Nil
Roast Pork and Gravy	26	80	Nil	640	100	Nil	Nil	Nil
Lamb and Vegetable Curry	28	120	Nil	830	80	5	Nil	4 moulds
Freeze Dried Rice	30	2,100	Nil	18,600	1,900	Nil	Nil	Nil

*Salmonella, Staphylococci, E. coli type 1 were not detected and so are not included in Table 1.

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